Orthobiology: toward the new generation of implant materials

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Conventional orthopedic implants, primarily composed of metallic alloys and synthetic polymers, have long provided structural support and mechanical stability in musculoskeletal repair. Despite their success, these materials are biologically inert, often resulting in complications such as poor osseointegration, debris-induced inflammation, and eventual need for revision surgery.

Over recent decades, orthobiology has emerged as a promising alternative, aiming to restore damaged tissues to their native state by bridging the gap between traditional implant technology and regenerative medicine. The use of biologically active materials (such as growth factors, stem cells, and bioresorbable matrices) enhance repair processes, accelerate recovery, and improve long-term outcomes in bone and soft tissue healing.

This presentation will review the fundamental principles of orthobiology and their relationship with tissue engineering, emphasizing how biological stimulation complements mechanical stability in contemporary orthopedic interventions. Special attention will be given to emerging technologies, including 3D bioprinting, advanced biomaterial scaffolds, and cell-based therapies. The osteochondral module and other examples will be presented as case studies highlighting advances at the fundamental research level.